Groundwater & Nitrogen Modeling to Prioritize Management Strategies for Suffolk County’s Estuaries

NGWA Groundwater Summit 2017

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Suffolk County, New York

- Sole Source Aquifer for >1.5 million people
- > 800 community public supply wells
- 74% of Suffolk County is un-sewered
- Risk of elevated nitrogen & other contaminants
- Drinking water and surface water concerns

Subwatersheds Wastewater Plan

- Establish first order nitrogen load reductions for surface water restoration
- Protection of groundwater (drinking water)

Project Components

- Delineate subwatersheds
  - Groundwater flow model
  - Baseflow contribution by travel time
  - Highlight areas of particular concern (depth to water, SLOSH)
- Estimate nitrogen load
- Surface water modeling for residence times
- Establish tiered priority areas and rank watersheds
- Nitrogen load reduction requirements
- Evaluate wastewater alternatives & pilot areas
- Simulate 200 year “equilibrium” nitrogen concentrations based on existing and future conditions
- Develop subwatershed wastewater plan
**Groundwater Model Code Suite**

- DYNSYSTEM – finite element
- DYNFLLOW
- DYNFLOW
- DYNSWIM
- DYNTTRACK

- DYNTTRACK
- Random walk method
- Dispersive particles
- Codes modified for this application
  - > 500,000 model nodes
  - 200,000,000 particles

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**Subwatershed Simulations**

- 191 Water bodies
  - 134 estuaries
  - 19 lakes
  - 38 streams
- Refine regional groundwater models
- Node discretization on the order of 50-100 feet near waterbodies

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**Delineate Subwatersheds**

- Simulated Water Table under Steady-State Conditions (2012-2013)
- Simulated Water Table (ft, msl)
  - Low: 0
  - High: 6

- West Neck Bay

<table>
<thead>
<tr>
<th>Simulated Water Table (ft, msl)</th>
<th>Temporal Zone</th>
<th>% of Total Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 2</td>
<td>46%</td>
<td></td>
</tr>
<tr>
<td>2 to 19</td>
<td>38%</td>
<td></td>
</tr>
<tr>
<td>10 to 25</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>25 to 50</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>&gt; 50</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Low to High</td>
<td>46%</td>
<td></td>
</tr>
<tr>
<td>High to 250</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>100 to 200</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>

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**NGWA Groundwater Summit 2017**
Nitrogen Load Estimates

- Nitrogen loading calculated using spreadsheet "models"
- Nitrogen Loading Model (NLM)
- NJ Nitrate Dilution Model
- Others...

Major Assumptions

- Vetted through Committee
  - SCDHS, NYSDEC, USGS, Stony Brook University, CDM Smith
- On-Site Wastewater Systems
  - Residential, Non-Residential
  - Attenuation factors (through tank, plume, aquifer)
- Fertilizer
  - Application rates, losses, leaching rates
  - Agriculture, turf (golf, residential, rec fields)
- Animals (dogs, cats)
- Atmospheric Deposition
  - NOAA station
- Geology
  - Till vs Outwash

Verification of N Loading Parameters

- Need to validate assumptions
  - Monitoring wells?
  - Community water supply wells
- Run nitrogen loading simulations and compare to observed [N] in shallow water supply wells
**Summary**

- Nitrogen load calculations using spreadsheet models OK for first approximation
- Models allow for better evaluation of management strategies, especially for complex systems
  - Allow for incorporation of hundreds of thousands of point sources
  - Account for intertwined hydraulics (water supply wells, all water bodies that receive groundwater baseflow)
  - Evaluate management scenarios & time to benefit
- Assumptions need to be vetted by stakeholders and validated, preferably with supply wells

**Next Steps**

- Complete subwatershed and nitrogen load modeling for all 191 subwatersheds
- Rank subwatersheds county-wide using:
  - N load
  - Residence time
  - Water quality data
- Run scenarios

**Thank You**

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